United States Environmental Protection Agency
Office of Solid Waste and Emergency Response
Publication 9200.3-23FS
EPA 540/F-96/018
PB96-963245
September 1996

EPA The Role of Cost in the Superfund Remedy Selection Process

Office of Emergency and Remedial Response — Quick Reference Fact Sheet

This fact sheet describes the role of cost in the selection of remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly referred to as Superfund). Cost is a central factor in all Superfund remedy selection decisions. The objective of this fact sheet is to clarify the current role of cost as established in existing law, regulation, and policy. This fact sheet does not elevate or establish a new role for cost in the Superfund program, but rather describes the current role of cost as established by the Superfund statute (CERCLA) and the Superfund regulations (the National Oil and Hazardous Substances Contingency Plan (NCP)), and as expanded upon in EPA guidance.

Through the distribution of this fact sheet, EPA hopes to ensure that all stakeholders involved in the Superfund process fully understand the important role that cost plays in remedy selection under existing law and policy, and to summarize recent initiatives aimed at enhancing the cost-effectiveness of remedial actions. These initiatives include the National Remedy Review Board, Remedy Selection Rules of Thumb, and Updating Remedy Decisions.

❶ STATUTORY AND REGULATORY CONTEXT FOR THE CONSIDERATION OF COST

Understanding the role of cost in the Superfund remedy selection process requires an understanding of the statutory and regulatory provisions that guide this process. CERCLA established five principal requirements for the selection of remedies. Remedies must:

1) Protect human health and the environment;

2) Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;

3) Be cost-effective;

4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and

5) Satisfy a preference for treatment as a principal element, or provide an explanation in the Record of Decision (ROD) why the preference was not met.

The NCP sets forth the Remedial Investigation/Feasibility Study (RI/FS) process for gathering the information necessary to select a remedy that is appropriate for the site and fulfills these statutory mandates. The RI includes sampling and analysis to characterize the nature and extent of site contamination, performance of a baseline risk assessment to assess the current and potential future risks to human health and the environment posed by that contamination, and the conduct of treatability studies to evaluate the potential costs and effectiveness of treatment or recovery technologies in reducing the toxicity, mobility, or volume of specific site waste. The FS includes the development and screening of alternative remedial actions, and the detailed evaluation and comparison of the final candidate cleanup options. Typically, a range of options is developed during the FS concurrently with the RI site characterization, with the results of each influencing the other in an iterative fashion.

The NCP also lays out a two-step selection process, in which a preferred remedial action is presented to the public for comment in a Proposed Plan, which summarizes preliminary conclusions as to why that option appears most favorable based on the information available and considered during the FS. Following the receipt and evaluation of public comments on the Proposed Plan, which may include new information (e.g., a fuller view of community

input on the options, new information on technology performance), the decision maker makes a final decision and documents the selected remedy in a ROD. For a general discussion of this process, see EPA's *"Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA Interim Final," OSWER Directive 9355.3-01, October 1988,* and *"Guide to Selecting Superfund Remedial Actions," OSWER Directive 9355.0-27FS,* hereinafter referred to as the RI/FS Guidance and the Remedy Selection Guidance, respectively.

In addition to the items discussed in more detail below, it is important to keep in mind that remedial action costs are influenced, in general, by the quality of the conceptual site model (CSM), which is a three-dimensional "picture" of site conditions that illustrates contaminant distributions, release mechanisms, exposure pathways, migration routes, and potential receptors. The CSM documents current site conditions and is supported by maps, cross sections, and site diagrams that illustrate what is known about human and environmental exposure through contaminant release and migration to potential receptors. It is initially developed during the scoping phase of the RI/FS, and modified as additional information becomes available. Careful evaluation of site risks, incorporating reasonable assumptions about exposure scenarios and expected future land use, and the definition of principal threat waste generally warranting treatment, help to prevent implementation of costly remediation programs that may not be warranted.

In addition, EPA expects that the appropriately consistent application of existing national policy and guidance will result in the selection of cost-effective remedies. Guidance that promotes cost-effective decision making includes the Presumptive Remedy series, Soil Screening Guidance, and Land Use Guidance. For more information, see OSWER Directives 9355.0 - 47FS, 9355.4-14FSA, and 9355.7-04, respectively.

❷ CONSIDERATION OF COST DURING THE DEVELOPMENT AND SCREENING OF ALTERNATIVES

During the first step of the FS, a range of remedial alternatives is developed and then screened in order to identify those alternatives that should be considered in more detail. Cost estimates developed for each option comprise the short- and long-term cost of remediation, including capital costs (e.g., the costs to put remedial technology in place, including those for equipment, labor, materials, and services), and the annual costs of operations and maintenance (O & M) for the entire period during which such activities will be required. Costs should be discounted to a common base year to evaluate expenditures over time. A discount rate of seven percent before taxes and after inflation should be used to account for the time value of money (see *"Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis," OSWER Directive 9355.3-20, June 25, 1993*). A more complete description of remedial action cost estimating can be found in the RI/FS Guidance.

Development of Alternatives

In elaborating the RI/FS process, the NCP instructs decision makers on how to implement both the mandate to utilize permanent solutions and treatment to the maximum extent practicable and the requirement to select remedial actions that are cost-effective. Specifically, the NCP establishes the program goal and expectations found at 40 CFR 300.430(a)(1)(iii) (See Exhibit 1). These expectations identify the appropriate methods of protection which generally should guide the development of cleanup options for common types of site situations, while allowing flexibility to modify these expectations to take into account truly unique site circumstances.

The NCP states that the overall goal of the remedy selection process is "to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste" *(40 CFR 300.430(a)(1)(i)).* This goal reflects CERCLA's emphasis on treatment as the preferred method of protection. However, recognizing that CERCLA tempers its emphasis on permanent solutions and treatment through the addition of the qualifier "to the maximum extent practicable," and also contains the co-equal mandate for remedies to be cost-effective, the NCP goes on to state that, in general, "EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials" *(40 CFR 300.430(a)(1)(iii)(A))* (see *"A Guide to Principal Threat and Low Level Threat Wastes," Publication 9380.3-06FS, November 1991).*

At the same time, "EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable," and to combine these

Exhibit 1

PROGRAM EXPECTATIONS

Protection of human health and the environment can be achieved through a variety of methods: treatment to destroy or reduce the inherent hazards posed by hazardous substances, engineering controls (such as containment), and institutional controls to prevent exposure to hazardous substances. The NCP sets out the types of remedies that are expected to result from the remedy selection process (Sec. 300.430(a)(1)(iii)).

➤ ***Treat principal threats, wherever practicable.*** Principal threats for which treatment is most likely to be appropriate are characterized as:

- Areas contaminated with high concentrations of toxic compounds;
- Liquids and other highly mobile materials;
- Contaminated media (e.g., contaminated ground water, sediment, soil) that pose significant risk of exposure; or
- Media containing contaminant concentrations several orders of magnitude above health-based levels.

➤ ***Appropriate remedies often will combine treatment and containment***. For a specific site, treatment of the principal threats(s) may be combined with containment of treatment residuals and low-level contaminated material.

➤ ***Containment will be considered for wastes that pose a relatively low long-term threat or where treatment is impracticable.*** These include wastes that are near health-based levels, are substantially immobile, or otherwise can be reliably contained over long periods of time; wastes that are technically difficult to treat or for which treatment is infeasible or unavailable; situations where treatment-based remedies would result in greater overall risk to human health or the environment during implementation due to potential explosiveness, volatilization, or other materials handling problems; or sites that are extraordinarily large where the scope of the problem may make treatment of all wastes impracticable, such as municipal landfills or mining sites.

➤ ***Institutional controls are most useful as a supplement to engineering controls for short- and long-term management.*** Institutional controls (e.g., deed restrictions, prohibitions of well construction) are important in controlling exposure during remedial action implementation and as a supplement to long-term engineering controls. Institutional controls alone should not substitute for more active measures (treatment or containment) unless such active measures are found to be impracticable.

➤ ***Innovative technologies should be considered if they offer the potential for comparable or superior treatment performance, fewer/lesser adverse impacts, or lower costs for similar levels of performance than demonstrated technologies.***

➤ ***Ground waters will be returned to their beneficial uses wherever practicable within a timeframe that is reasonable given the particular circumstances of the site.***

methods and use of institutional controls, as appropriate, at sites with both types of contaminated materials *(40 CFR 300.430(a)(1)(iii)(B) and (C)).*

In addition, "EPA expects to use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants. . .. The use of institutional controls shall not substitute for active response measures (e.g., treatment and/or containment of source material, restoration of ground waters to their beneficial uses) as the sole remedy unless such active measures are determined not to be practicable, based on the balancing of trade-offs among alternatives that is conducted during the selection of remedy" (*40 CFR 300.430(a)(1)(iii)(D)).*

The NCP also contains the following expectation for Ground Water Response Actions: "EPA expects to return usable ground waters to their beneficial uses

whenever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction" *(40 CFR 300.430(a)(1)(iii)(F))*. This recognizes that there may be particular site circumstances (e.g., DNAPL in fractured bedrock) where complete restoration will not be practicable.

These Superfund program expectations guide the development of remedial alternatives during the FS. Although cost is not a specific element of the Superfund program expectations, the recognition that different waste management approaches (i.e., combinations of treatment, containment, and institutional controls) may be appropriate at different sites depending on the types of threats posed, reflects a "built-in" sensitivity to the issue of cost in the Superfund remedy selection process (e.g., large sums of money should not be spent treating low-level threat wastes). These expectations reflect EPA's belief that certain source materials are generally addressed best through treatment because of technical uncertainties regarding the long-term reliability of containment of these materials, and/or the serious consequences of exposure should a release occur. These expectations also reflect the conclusion that other source materials generally can be reliably contained.

Screening of Alternatives

The NCP describes cost as one of three "screening" criteria (the others being effectiveness and implementability) used to identify higher cost alternatives that should not be carried forward for detailed evaluation. Alternatives may be screened out if they:

1. Provide "effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost" *(40 CFR 300.430(e)(7)(iii))*.

2. Have costs that are "grossly excessive compared to [their] overall effectiveness" *(40 CFR 300.430(e)(7)(iii))*. For example, the costs associated with treating a complex mixture of heterogeneous wastes without discrete hot spots (e.g., a large municipal landfill) would likely be considered excessive in comparison to the effectiveness of such treatment. As a result, a treatment alternative for such a site would likely be eliminated from consideration during the screening process.

Cost estimates at the alternative screening stage should focus on relative, rather than absolute, accuracy. At the screening stage, it may also be unnecessary to evaluate costs that are common to all alternatives.

❸ CONSIDERATION OF COST DURING THE DETAILED ANALYSIS OF ALTERNATIVES AND THE IDENTIFICATION OF A PREFERRED ALTERNATIVE

The purpose of the detailed analysis is to objectively assess the alternatives with respect to nine evaluation criteria that implement the statutory provisions of CERCLA section 121. This analysis consists of an individual evaluation of each alternative with respect to each criterion, and a comparison of options designed to determine the relative performance of the alternatives and identify major trade-offs among them (i.e., relative advantages and disadvantages) with respect to the same factors.

The decision maker uses information assembled and evaluated during the detailed analysis in selecting a remedial action. Cost estimates at the detailed analysis stage should capture all remedial costs and, whenever possible, should provide an accuracy of +50 percent to -30 percent. Sensitivity analysis may be warranted if a cost estimate might vary significantly with relatively small changes in the underlying assumptions, especially those concerning the effective life of a remedial action, the O & M costs, the duration of cleanup, site characteristics (e.g., volume of contaminated material), and the discount rate *(RI/FS Guidance, page 6-12)*.

The actual process of selecting a Superfund remedy is the decision making bridge between development of remedial alternatives during the FS and documentation of the selected remedy in a ROD. The process begins with the identification of a preferred remedial alternative from among those developed in the FS. This preferred alternative is then presented to the public for comment in the form of a Proposed Plan. Based on the review of public comments, a final remedy selection decision is made and documented in a ROD.

Cost is a critical factor in the process of identifying a preferred remedy. In fact, CERCLA and the NCP require that every remedy selected must be cost-effective. A brief summary of the relationship between the nine remedy selection criteria and the five principal statutory remedy selection requirements will provide a useful context for a discussion of the role of cost in the remedy selection process. For a more detailed discussion of the nine criteria and the remedy selection process in general, see EPA's Remedy Selection Guidance.

Relationship Between the Nine Criteria and Statutory Requirements for Remedy Selection

During the remedy selection process, nine evaluation criteria are considered in distinct groups which play specific roles in working toward the selection of a remedy that satisfies the five principal statutory requirements. The nine evaluation criteria include two "threshold" criteria, five "balancing" criteria (including cost), and two "modifying" criteria (state and community acceptance), as illustrated in Exhibit 2. The modifying criteria are considered to the extent possible during the process leading up to and including the Proposed Plan, and are fully considered after public comments on that plan have been received. Following receipt and consideration of public comments, including any new information they might contain, the decision maker makes a final decision which is documented in the ROD.

The first two statutory requirements -- protection of human health and the environment, and compliance with ARARs (unless a waiver is justified) -- are embodied in the two threshold criteria. A remedial alternative must satisfy these two requirements to be eligible for further evaluation against the other seven factors.

Advantages and disadvantages of alternatives that satisfy the threshold criteria are balanced using the five balancing criteria, and the two modifying criteria (if there is enough information to consider these latter criteria in advance of the formal public comment process). This balancing determines which option represents the remedy that utilizes "permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable" (MEP) for that site *(40 CFR 300.430(f)(1)(ii) (E))*. The decision maker considers the statutory preference for treatment as an "overlay" to inform and direct this balancing (*id.*).

The alternatives are also separately evaluated against a subset of the criteria to make the determination of which option(s) satisfy the statutory cost-effectiveness. A remedial alternative is cost-effective if its "costs are proportional to its overall effectiveness" *(40 CFR 300.430(f)(1)(ii)(D))*. Overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria: long-term effectiveness and permanence; reduction in toxicity, mobility and volume (TMV) through treatment; and short-term effectiveness (See Exhibit 3). Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective (*id.*).

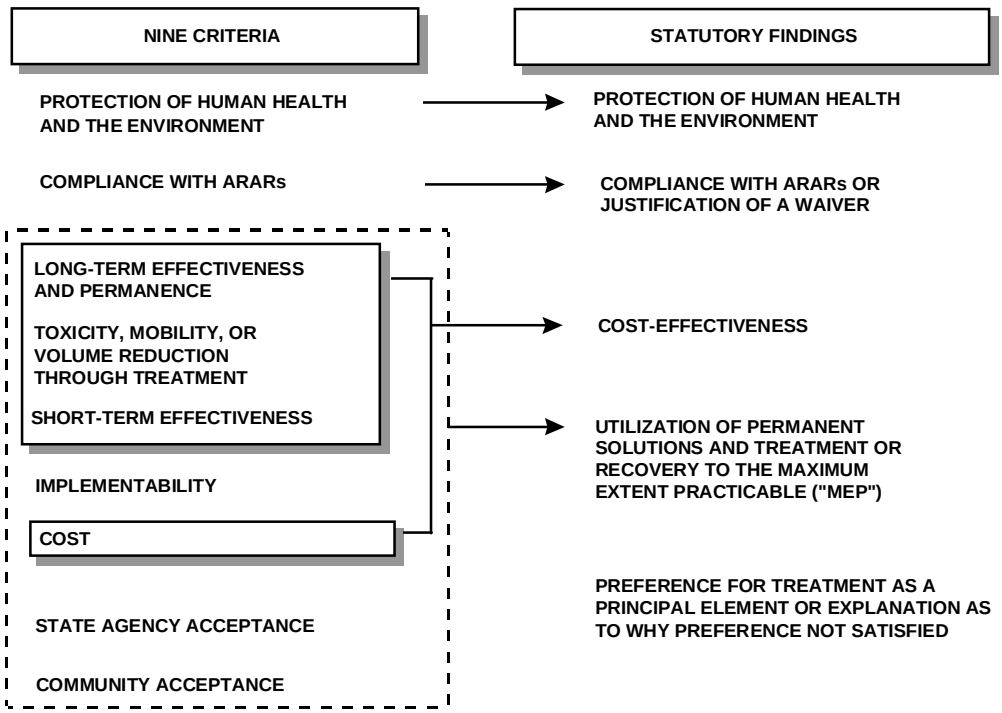
Cost considerations are therefore factored into the balancing of alternatives in two ways. Cost is factored into the determination of cost-effectiveness, as described above. And, cost is evaluated along with the other balancing criteria in determining which option represents the practicable extent to which permanent solutions and treatment or resource recovery technologies can be used at the site. This balancing emphasizes two of the five criteria (long-term effectiveness and permanence, and reduction of TMV through treatment) *(40 CFR 300.430(f)(1)(ii)(E))*. However, in practice, decisions typically will turn on the criteria that distinguish the different cleanup options most. The expectations anticipate some of the likely tradeoffs in several common situations, although site-specific factors will always play a role.

The Role of Cost in Determining Whether to Waive ARARs

Section 121 of CERCLA specifies that all remedial actions must "meet any Federal standards, requirements, criteria or limitations that are determined to be legally applicable or relevant and appropriate requirements." Specific statutes cited in CERCLA that might present such an ARAR include the Solid Waste Disposal Act, the Toxic Substances Control Act, the Safe Drinking Water Act, the Clean Air Act, the Clean Water Act, and the Marine Protection Research and Sanctuaries Act. In addition to the Federal ARAR requirement, remedial actions must meet any applicable or relevant and appropriate promulgated State standard, requirement, criterion or limitation if it is more stringent than the corresponding Federal requirement. As previously discussed, compliance with ARARs is one of the two threshold criteria for the selection of a preferred remedy.

Exhibit 2

RELATIONSHIP OF THE NINE CRITERIA TO THE STATUTORY FINDINGS



Cost is not a factor in the identification of ARARs. However, CERCLA authorizes the waiver of an ARAR with respect to a remedial alternative if any one of six bases exist (See Exhibit 4). As described below, cost may be a consideration with respect to determining whether a technical impracticability, equivalent level of performance, or Fund-balancing waiver is warranted.

1. Technical Impracticability

Cost is relevant to the technical impracticability waiver, because engineering feasibility is ultimately limited by cost. EPA has stated that cost can be considered in evaluating technical impracticability, although it "should generally play a subordinate role" and should not be a major factor unless compliance would be "inordinately costly" *(55 FR at 8748, March 8, 1990).* Thus, the role of cost in evaluating technical impracticability is more limited than in the general balancing of tradeoffs with respect to the remedy selection criteria, but cost may be considered in certain cases.

2. Equivalent Level of Performance

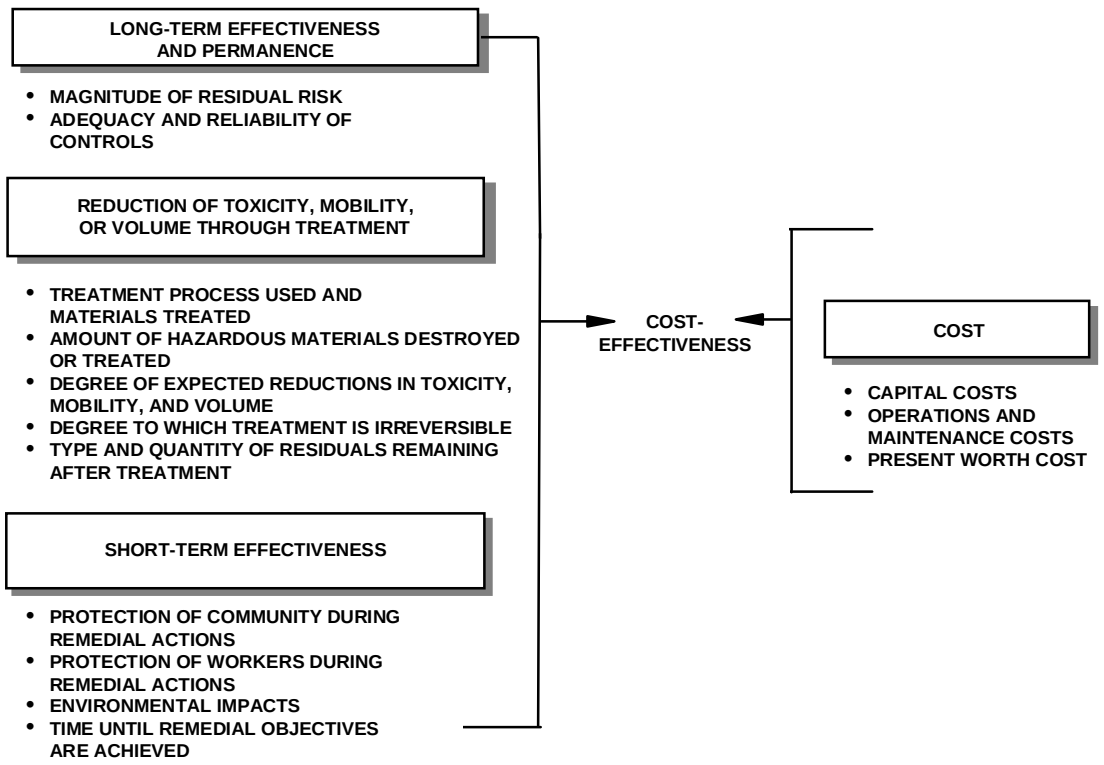
This waiver is available when an alternative will provide a level of performance equivalent to that required by the ARAR, but through an alternative design or method of operation. While cost is not considered in evaluating equivalence, this waiver can provide cost-saving flexibility in selecting remedies. Alternative, less expensive technologies that attain the same outcome (e.g., concentration of residuals) should be explored before concluding that a highly costly approach must be adopted because it is an action-specific ARAR.

3. Fund Balancing

For Fund-financed remedies, the fund-balancing waiver may be invoked when compliance with an ARAR would not provide a balance between the need to provide protection at a site and the need to address other sites. EPA's policy is to consider this waiver when the total cost of a remedy is greater than four times the national average cost of remediating an operable unit (currently, 4x$10 million, or $40 million), or in other cases where "EPA determines

Exhibit 3

ELEMENTS OF THE CERCLA REMEDY SELECTION COST-EFFECTIVENESS DETERMINATION



that the single site expenditure would place a disproportionate burden on the fund" *(55 FR at 8750).*

Consideration of Cost in Determining the Approach to Complying with ARARs

Even when waivers are not available, the NCP provides opportunity for cost-savings in achieving cleanup goals. For example, the NCP requires cleanup to relevant and appropriate Maximum Contaminant Levels (MCLs) and non-zero MCL goals (MCLGs) when remediating contaminated ground water whose beneficial use is as a drinking water source. However, the time frame over which the MCLs must be achieved may be adjusted, depending on such factors as whether the aquifer is currently being used or likely to be needed in the near future. In some cases, allowing for an extended time frame to achieve cleanup standards provides the opportunity to develop less intensive, lower cost alternatives.

❹ RECENT SUPERFUND REFORMS THAT PROMOTE COST-EFFECTIVENESS

The Administrative reforms announced in October 1995 include several initiatives that are intended, in part, to control remedy costs and further facilitate the achievement of cost-effective cleanup.

National Remedy Review Board

The National Remedy Review Board brings together senior EPA technical and policy experts to review and make recommendations on proposed cleanup actions at sites where the estimated cost for the preferred alternative is more than $30 million, or more than $10 million and 50% greater than the cost of the least costly, protective, ARAR-compliant alternative. Regional decision makers are expected to give the Board's recommendations substantial weight. However, other important factors may influence the final Regional decision, such as public comment or technical analysis of remedial options. This reform

does not supersede any delegated decision making authority.

Remedy Selection "Rules of Thumb and Management Review Triggers"

Rules of thumb consist of key principles and expectations corresponding to three major policy areas in the remedy selection process: assessment and management of risk; treatment of principal threats versus containment of low-level threat waste; and ground water response actions. The purpose of this initiative is to promote consistent, reasonable, and cost-effective decision making through the appropriate application of national policy and guidance. In addition, EPA is developing a set of "Management Review Triggers" that will flag senior EPA management attention to specific aspects of proposed remedies that should be examined closely to ensure they are justified by site-specific conditions. Together, rules of thumb and management triggers will become part of a standard list of Superfund issues on which Headquarters, Regions and States work together to ensure appropriate application of national policy and guidance.

Updating Remedy Decisions

The purpose of this reform is to encourage Superfund RODs. These updates are intended to bring past remedy decisions into line with the current state of knowledge with respect to remediation science and technology, and in so doing to improve the cost-effectiveness of site remediation while ensuring reliable protection of human health and the appropriate changes to remedies selected in existing environment. The primary focus of the "Update" reform effort will be ground water sites, as ground water science has advanced a great deal since the inception of the Superfund program. Three basic types of updates will be emphasized, although other types of updates are not excluded: a) where new remediation technology is available; b) where remediation objectives or approaches need revision; and c) where streamlining of a ground water monitoring program is reasonable.

Exhibit 4

BASES FOR ARAR WAIVERS

1. The alternative is an interim measure that will become part of a total remedial action that will attain the ARAR;

2. Compliance with the requirement will result in greater risk to human health and the environment than other alternatives;

3. Compliance with the requirement is technically impracticable from an engineering perspective;

4. The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method;

5. With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state; or

6. For Fund-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund monies to respond to other sites.